Heavy Loading of Freight Cars in the Transportation of Northwestern Apples

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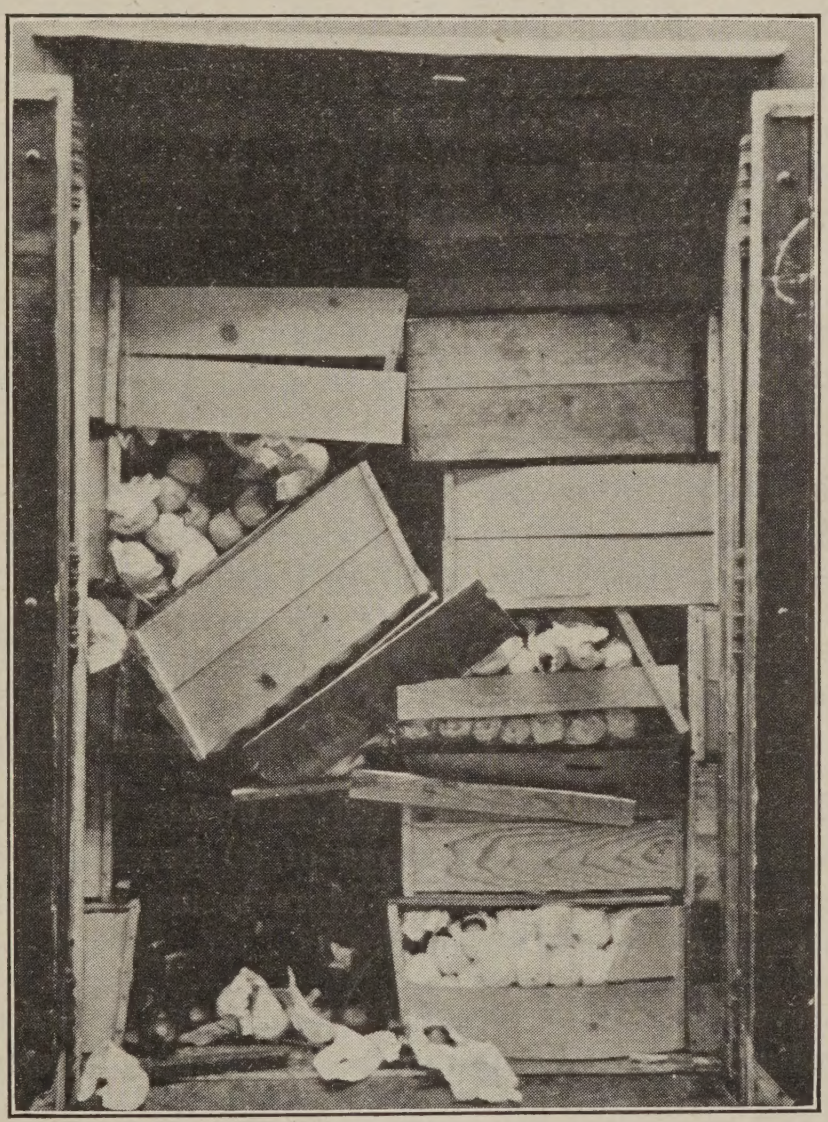

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF MARKETS
CHARLES J. BRAND, Chief

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SUMMARY

OWING to a serious car shortage, amounting to over 5,000 refrigerator cars prior to December 15, it was necessary during 1917 to load much heavier than during any previous season and to ship a considerable portion of the Northwestern apple crop in box cars.

Temperatures are maintained about 5° lower in carloads of apples under refrigeration having five layers of boxes than in cars having six layers. The higher temperature shortens the storage and market life of the fruit.

The temperatures of heavy and light loads are nearly the same when shipped under ventilation. When emergency demands heavy loading it should be done during the season of ventilated shipments.

Closing refrigerator car ventilators during the day, or when outside temperatures are high, gives lower and more uniform temperatures than standard ventilation.

More than a third of the box car shipments in 1917 were consigned to markets in Eastern States. Box cars should not be loaded with fruit subject to long-distance shipment.

Careless loading of Western apples during the season of 1917 caused an average breakage of 50 boxes per car in shipments to New York City. More secure car stripping and better bracing are required.

The severity of 1917 shipping troubles was intensified by disregarding indicated conditions. Car supply information and tonnage estimates should be coördinated by the shippers in advance of the shipping season for the best regulation of loading and shipping.

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CONDITIONS IN 1917

GREAT INCREASES in the production of apples in the Northwestern States coupled with critical car shortages seriously handicapped the efforts of the shippers and carriers to transport and market the Northwestern apple crop efficiently during the season of 1917–18. From a production of 14,775 carloads of apples in 1912 in the States of Washington, Oregon, Idaho, and Montana, shipments increased to more than 22,800 carloads for the season 1917–18. Various far-reaching causes resulted in an unprecendented national car shortage. This affected the available supply of refrigerator cars to the extent that during the week of November 9–15, 1917, carriers were able to supply but 423 refrigerator cars at shipping points where the minimum requirements for that week were 1,064 refrigerator cars, each loaded with 756 boxes. While this week marked the most acute stage of the car shortage for the season, its severity existed from October 12 to the end of the calendar year, resulting in the loading of 2,290 box cars in the principal shipping districts during this period. The average load in these box cars was 891.4 boxes. Further than this, the heavier loading of refrigerator cars, brought about by urgent appeals from many sources, resulted in raising their normal load of 630 boxes to an average of 763.1 during the period of heaviest movement (October 5 to December 15). On a basis of 665 boxes as a satisfactory carload, this shows that there was an actual shortage of 4,162 refrigerator cars up to December 15 in handling about half of the crop.

These conditions, anticipated by the Department of Agriculture, demanded that information be secured during the shipping season that would show how heavily refrigerator cars may be loaded for the safe shipment of apples, the best methods for handling such loads, and to what extent box cars may be safely used for this movement.

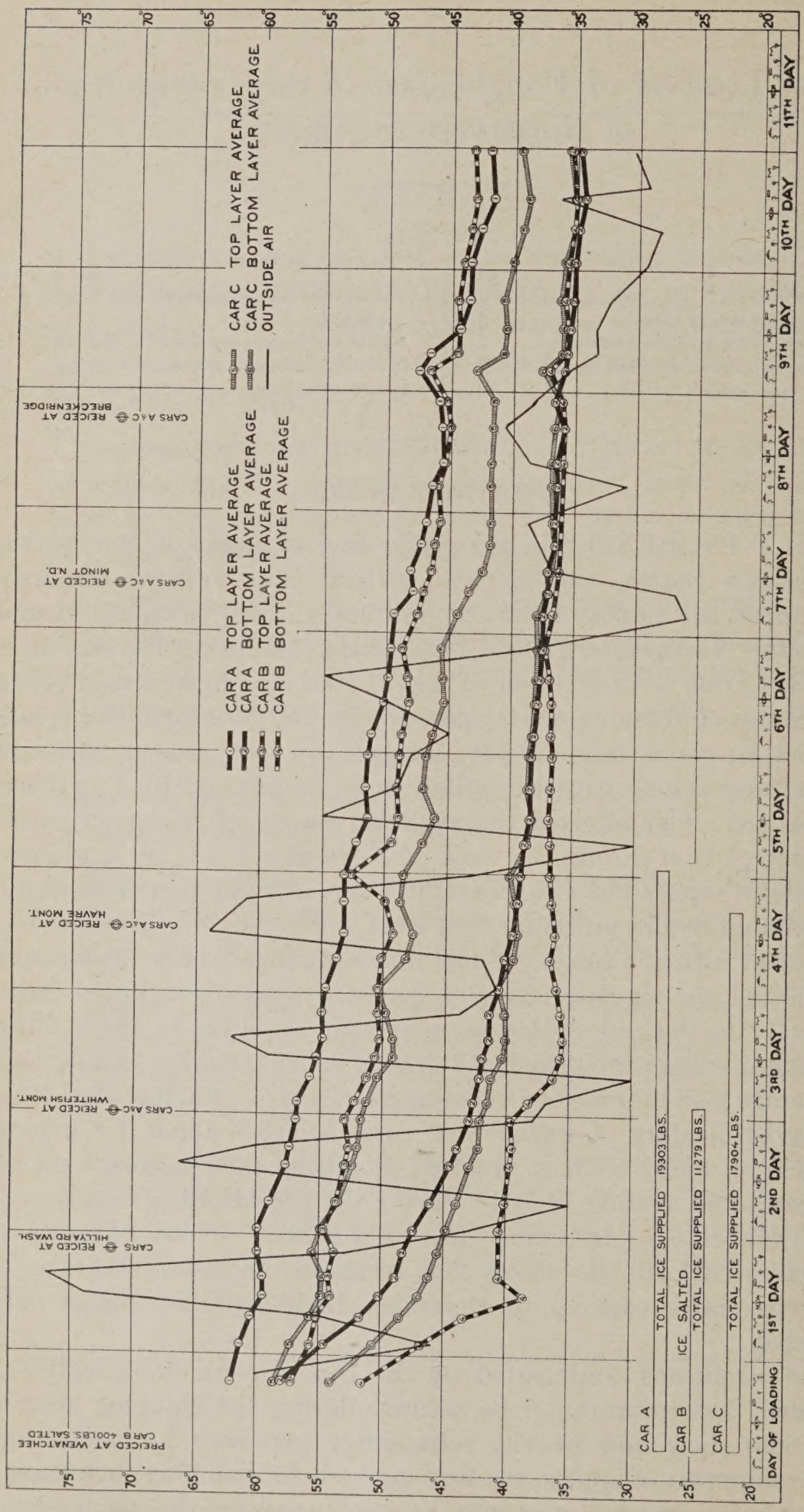

FIG. 1.—Average fruit temperatures in the top and bottom layers in refrigerator cars loaded with boxed apples. Car A having a heavy load, 756 packages, standard refrigeration; Car B, 756 packages, refrigeration salted, not re-iced after leaving Spokane; Car C, light load, 630 packages, standard refrigeration. These cars were in transit from Wenatchee, Wash., to Chicago, Ill., October 9–19, 1917.

In securing this information, consideration was given to temperatures in transit (factors influencing the keeping qualities of fruit on the market and in storage), to the breakage of packages and the condition of the fruit upon market arrival, and to the effect upon the channels of distribution.

TEMPERATURES IN HEAVY LOADS

By means of electrical resistance thermometers, temperatures of the fruit and air at 12 different points within the car may be taken from outside the car by a messenger who accompanies the shipment. The temperatures shown herewith were taken in this way. In discussing fruit temperatures, "average of top layer" represents the average of the fruit temperatures (second apple from package exterior) in the top layer of boxes at the following points: (a) center of the car, (b) quarter way, (c) adjacent to the ice bunker. "Average of bottom layer" represents an average of similar positions in boxes on the floor of the car. "Average fruit temperature" is the average of temperatures taken in all of the six named positions.

In figure 1 are shown such average temperatures taken in cars loaded with five layers (630 boxes) and with six layers (756 boxes) shipped under standard refrigeration. The light load maintained temperatures about 5° lower than the heavy load.

The trip during which these temperatures were taken was made with cars having both open and insulated bulkheads loaded heavily under standard refrigeration, and showed that one of the principal advantages of having insulated bulkheads and floor racks under these conditions lies in permitting the use of salt with the ice. The advantage in using salt and ice mixtures with heavy loads of fruit is well illustrated by the temperatures shown in figure 1. In this car 400 pounds of salt were applied at the time of loading. The car was re-iced but once thereafter. The temperature of the top layer was 5° lower than the top layer of a car similarly loaded under standard refrigeration, and was as low in temperature as the top layer in a light load. Since the car having the ice and salt mixture was not re-iced between Spokane and Chicago, this temperature had less fall during transit and the temperatures in the car under standard refrigeration gradually approximated them. The use of 3 to 4 per cent of salt with the ice at the time of loading will offset high temperature dangers in heavy loads, but the salt should be applied only in cars provided with properly constructed floor racks and with insulation in the bulkheads between the ice and the fruit.

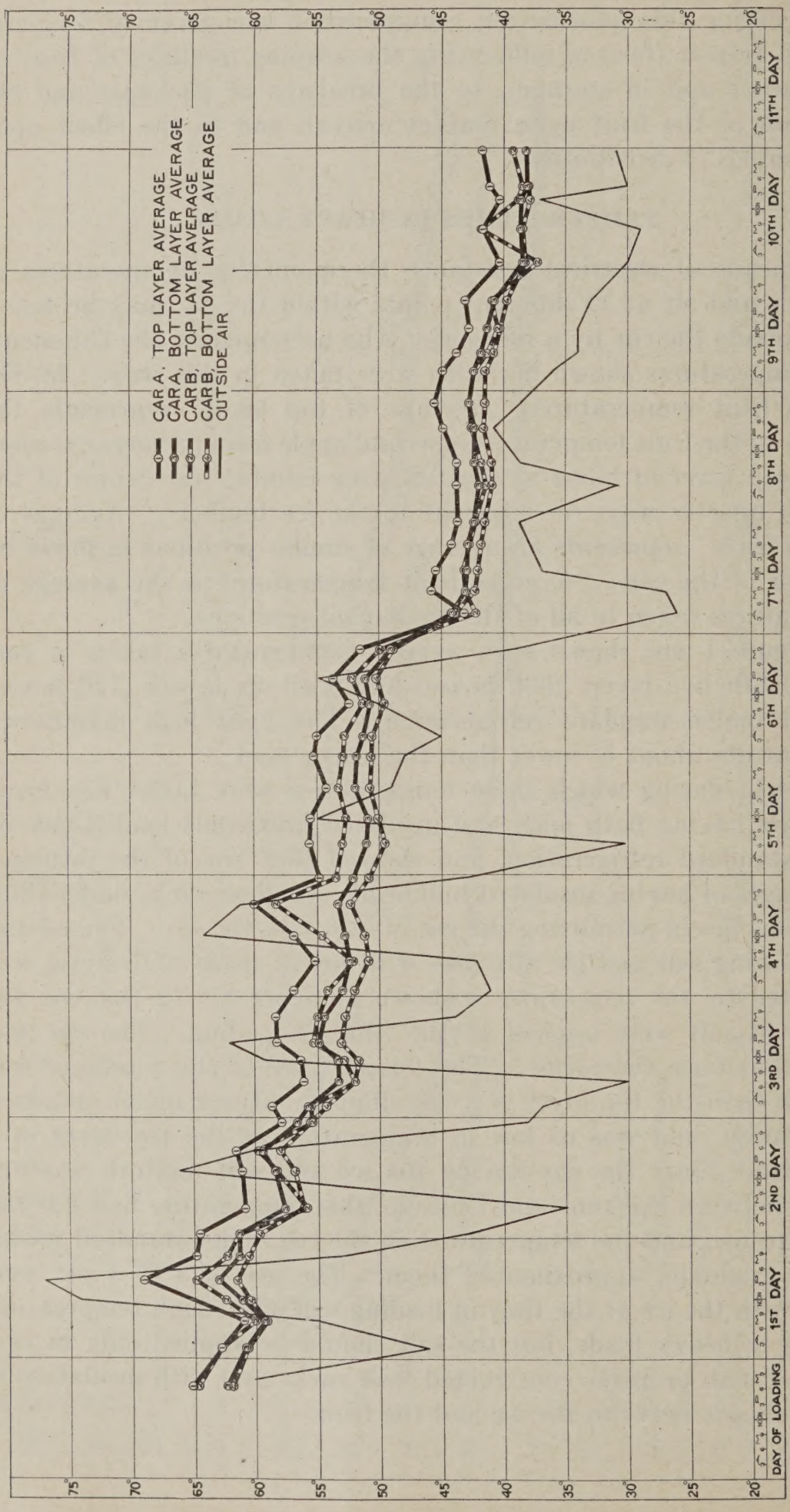

FIG. 2.—Average fruit temperatures in the top and bottom layers in refrigerator cars loaded with boxed apples shipped under standard ventilation. Car A, heavy load, 756 packages; Car B, light load, 630 packages. These cars were in transit from Wenatchee, Wash., to Chicago, Ill., October 9–19, 1917.

HANDLING HEAVY LOADS UNDER VENTILATION

Under standard ventilation the car ventilators are left open both day and night, unless the outside temperatures become dangerously low, regardless of how warm it becomes during the day. Under controlled ventilation, the ventilators are closed when the outside temperatures become higher than those of the fruit. When shipped under ventilation there is no great difference in temperature between cars heavily loaded and those with normal loads. This is illustrated in figure 2. Under ventilation the range in temperature between the top and bottom layers is less than under refrigeration, but the temperature of the load as a whole is not likely to be as low as when it is shipped under refrigeration unless the ventilated shipment passes through outside temperatures ranging below 40°. This is illustrated in figure 3, wherein comparision is made between the average fruit temperatures in heavy loads under standard refrigeration, standard ventilation and controlled ventilation. Great advantage is found in controlled ventilation over standard ventilation, since lower and more uniform temperatures are maintained where cars have ventilators closed when the outside temperatures are high.

FLUCTUATING TEMPERATURES IN BOX CARS

Temperature records of fruit shipped in box cars offered very conclusive evidence of the unsuitability of this type of equipment for apple shipments from the Northwest. Figure 4 shows the striking fluctuation in fruit temperatures under the influence of the changes in the outside air temperature. This chart also shows how little one or two ply of building paper protects the fruit from outside temperature changes. The box car has no provision for ventilation and offers neither protection from heat during the warm fall weather nor from freezing during a cold period, and is not suitable for long-distance shipments of apples.

Various methods of temporary insulation and heating were provided for box cars by shippers during the latter part of the shipping season. Figure 6 shows three methods of providing temporary insulation. Car B with an inner wall space 6 inches from the car wall filled with shavings gave the best results. The inner wall held the shavings in place, whereas in the car where the shavings were separated from the fruit load by building paper only the shavings settled somewhat and part of the top became uncovered. The eel-grass quilt offered a protection approximating that of the shavings for short periods of cold weather owing to the very efficient manner in which it was applied. These cars were subjected to a temperature of 13° below zero for a few hours with but slight frost damage on the floor.

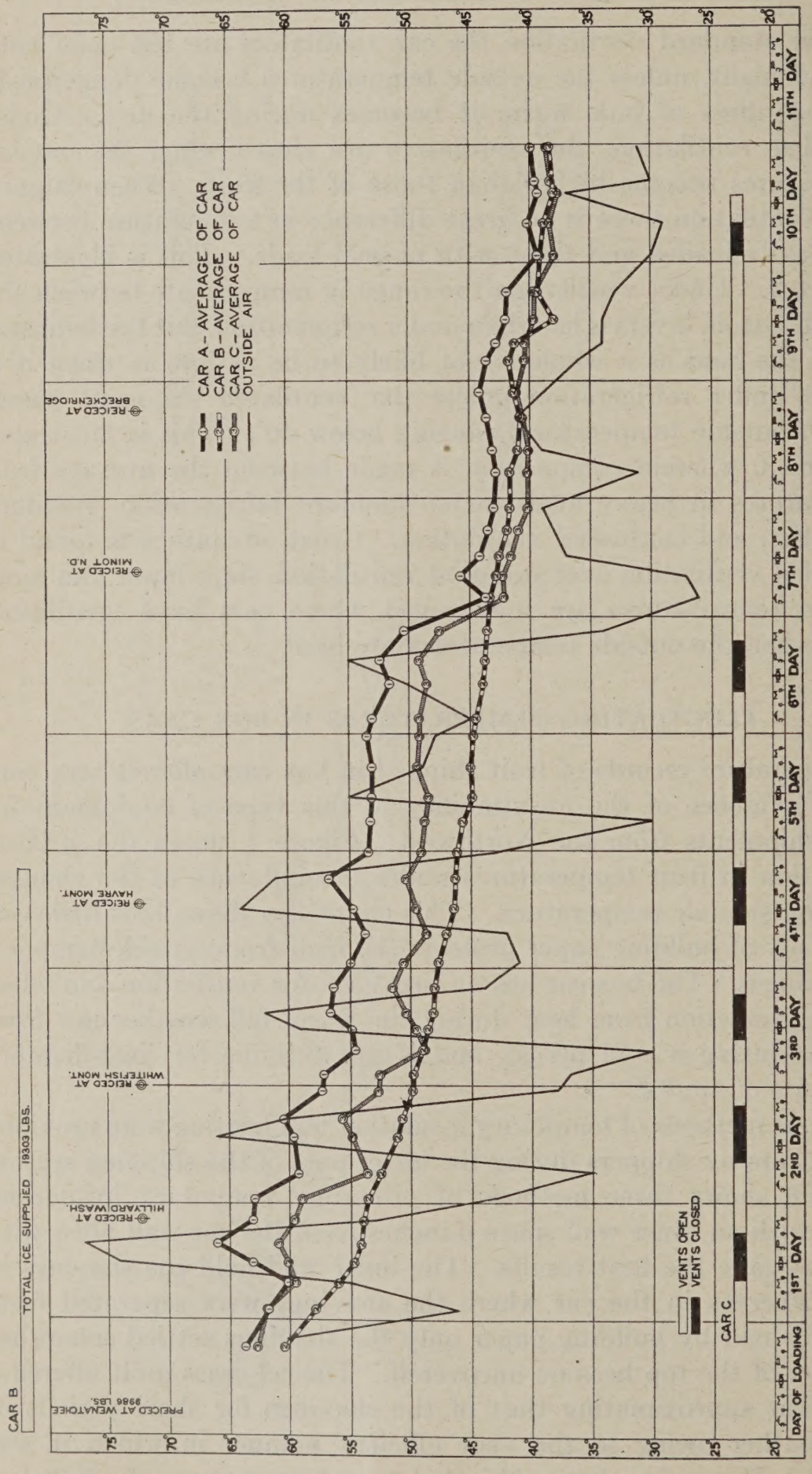

FIG. 3.—Average fruit temperatures in refrigerator cars loaded with boxed apples six layers high, 756 packages. Car A, standard ventilation; Car B, standard refrigeration; Car C, controlled ventilation. These cars were in transit from Wenatchee, Wash., to Chicago, Ill., October 9–19, 1917.

Various other temporary insulation materials and methods have been used, such as straw in place of shavings, building paper, and a combination of paper sheathing and air spaces. All temporary insulation of box cars is expensive and provides uncertain protection.

In heating box cars the best results are obtained by placing the stove in the center of the car and providing an air passage about the fruit inside the temporary insulation. It is especially important that provision be made at the floor and at the ends of the load for the circulation of the heated air.

CONDITION UPON MARKET ARRIVAL

Inspections were made during the shipping season in Minneapolis, Chicago, and New York, to determine the effect of heavy loading upon the fruit and upon the condition of the packages when unloaded. The Minneapolis and Chicago inspections indicated no apparent injury to the fruit when loaded six boxes high, but serious shifting and breakage was reported. Of 27 box cars inspected, six were frozen, and one was overripe. Cars loaded through the center without bracing were subject to freezing about the doors. Out of 86 cars inspected, 17 loads had shifted, 10 of them because of poor and insufficient car stripping. Loading on 2″ x 4″ or 2″ x 2″ strips resulted in damage, as the boxes tilted or slipped off of the strips.

The New York inspections constitute a more comprehensive test on account of the accumulated effect of the longer period in transit. The average time in transit for the 58 cars from the State of Washington was 24.3 days; six cars from California, 20.8 days; nine cars from Idaho, 19 days; seven cars from Oregon, 20.3 days. Out of 66 refrigerator cars inspected, nine arrived with contents overripe, seven of these cars were loaded six boxes high, with Jonathan, Winter Banana, and Spitzenberg varieties shipped under ventilation late in the season. Since the temperatures in transit (fig. 2) are very nearly the same in heavy and light loads shipped under ventilation, the overripeness found cannot be attributed to overloading. Nine out of the 14 box cars inspected contained fruit overripe; one had been frozen.

EXCESSIVE BREAKAGE CAUSED BY POOR LOADING METHODS

The additional journey from Chicago to New York resulted in an increased breakage which presents striking evidence in support of the Chicago-Minneapolis report and emphasizes the fact that better methods must be used in carloading, especially with heavy loads and box cars. In the 80 cars inspected, an average of 50 broken boxes per car was found. This breakage was much greater in the heavy loads than in the light loads, and was greater in the box cars than in the refrigerator cars. (See fig. 5.)

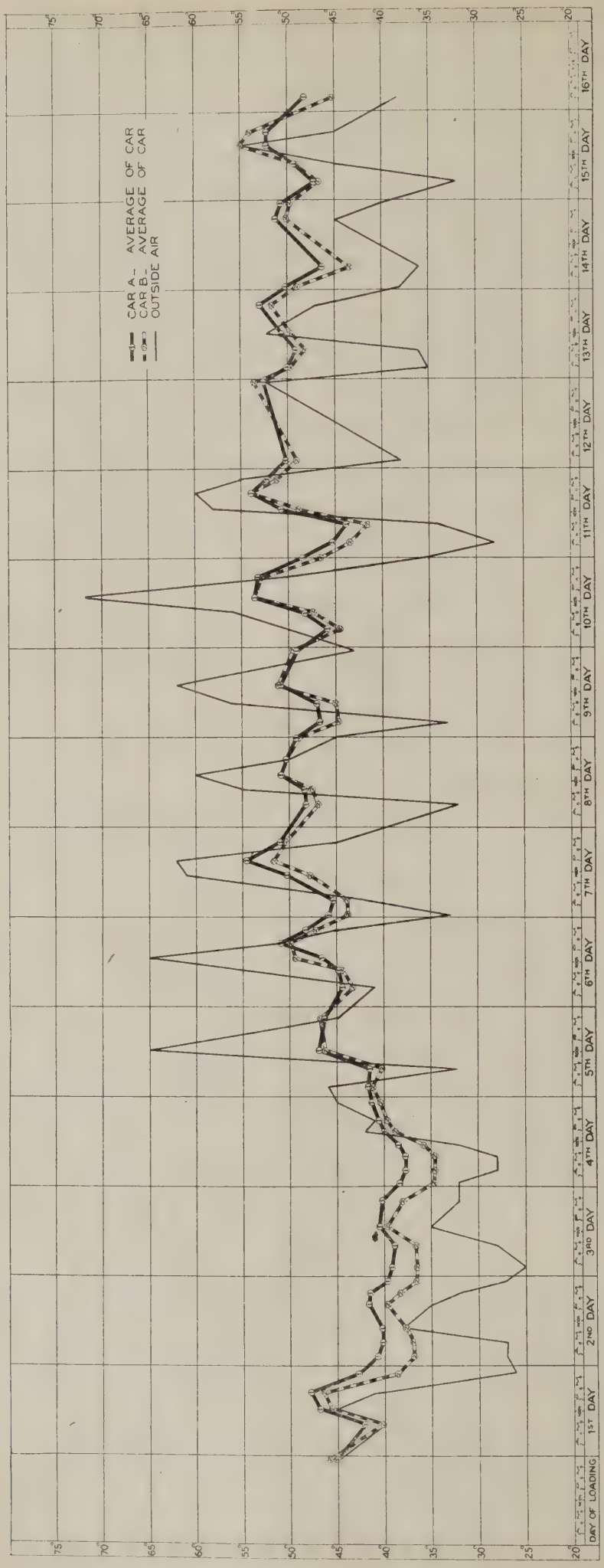

FIG. 4.—Average fruit temperatures in five similar positions in two box cars loaded with boxed apples. Car A having a 2-inch air space and two ply of paper on the floor with one ply of paper on sides, ends and top of load; Car B having a 2-inch air space and four ply of paper on the floor with two ply of paper on sides, ends and top of load. These cars were in transit from Wenatchee, Wash., to Pittsburgh, Pa., October 27 to November 12, 1917.

Careless carloading of apples is responsible for the annual breakage of thousands of boxes. Often but a car strip on one end of a box is used on the third and top layers and these are lightly nailed. While broken boxes are coopered at destination and sold, the cost of coopering, the low prices received, and the resulting decay of the apples from bruises aggregate a tremendous annual loss.

Fifty-six of the eighty loads inspected in New York had shifted, 51 because of poor or insufficient stripping, the others because of poor bracing. Shifting as a result of poor stripping is to one side of the car, causing a gap into which the loosened boxes tumble, effecting a jumbled load and broken boxes. Car strips running full length across the car do not possess great advantage over lath used as strips, if the latter are used in sufficient quantity and are well nailed in proper position.

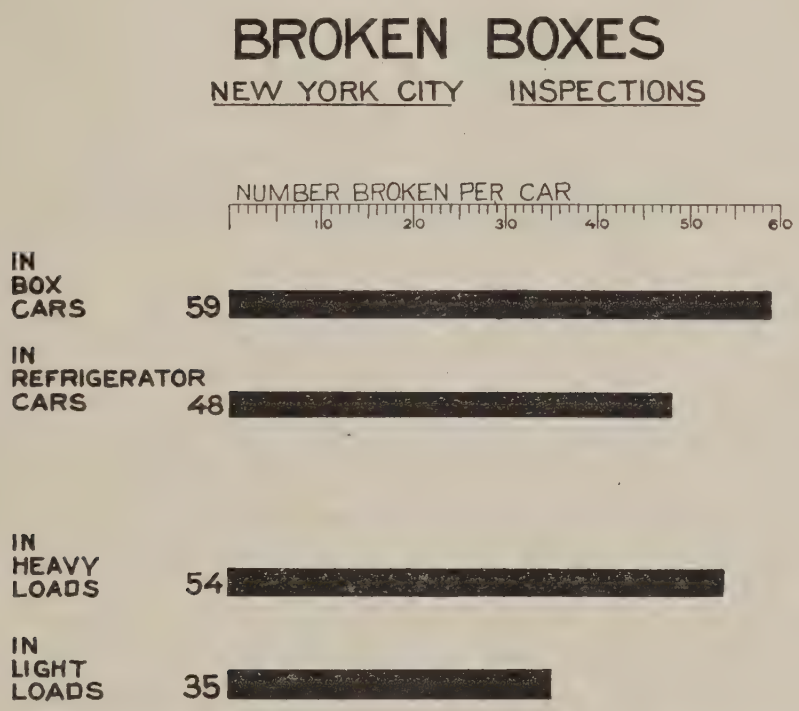

Fig. 5.—Average number of broken boxes found in eighty carloads of apples from the Pacific Coast upon arrival in New York City.

The continual weaving movement of the car in motion has a twisting effect upon the boxes beneath the strips. Several days of this action, combined with vertical vibration, or "jumping," together with sudden end-thrusts, when stopping or shunting, work the nails out of the top strips. With the top layer released, the lower strips also work loose, whereupon the whole load shifts to one side or the other. By tight squeezing and bracing, and by secure stripping, this movement of the boxes may be decreased so that the heavier nails recommended in the top stripping will stay in place sufficiently long to allow delivery of the car without shifting of the load.

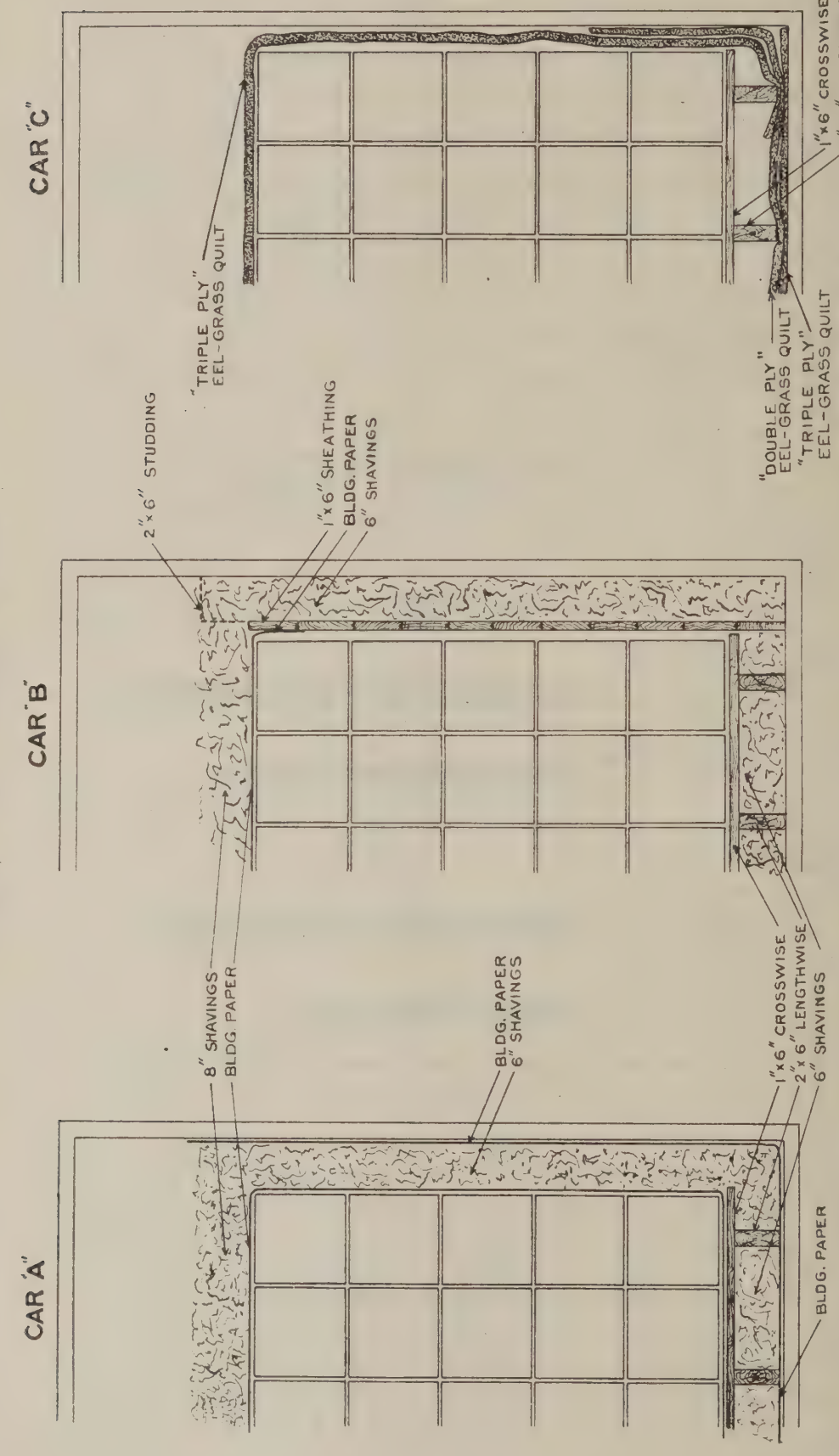

FIG. 6.—Methods of installing temporary insulation in box cars to protect fruit against freezing. This insulation is used for a single trip, giving protection that is uncertain and often causing overripeness through lack of ventilation.

RELATION OF HEAVY LOADING TO DISTRIBUTION

By loading cars with 756 boxes instead of 630, about 3,000 less refrigerator cars are required to move the Northwestern apple crop. During extreme car shortages, heavy loading will assist in the distribution of the crop during the fall buying season and at the same time facilitate winter distribution by placing a large supply of fruit in market centers before cold weather restricts shipments.

On the other hand, heavy loading restricts distribution by (a) rendering carlot sales difficult in small towns, thus changing some of this trade to a less-than-carload basis, and (b) making satisfactory carload inspections impossible. Limiting the supplies of small towns to less-than-carlot shipments from larger distributing centers makes this important distributing outlet more difficult to reach and seriously restricts sales and consumption.

The prevention of satisfactory carload inspection is the most serious handicap that heavy loading imposes upon the distribution of apples. In order that Federal inspectors and prospective purchasers may inspect cars properly, it is essentail that there be sufficient space between the top of the load and the ceiling for the opening or removal of packages.

METHODS OF SHIPPING DURING 1917 SEASON

The following tables were compiled from a large number of weekly shipments out of the Northwest to show to what extent heavy loading was practiced, when heavier loading and the use of box cars was started, the proportion of box cars used, and the distance of shipment.

The refrigerator carloads shown herewith were shipped either under ice, ventilation, or heat. Shipments began to move freely under ventilation during the last week in September, and reached their greatest volume during the week of October 12 to 18. With the exception of the Yakima district, where messengers were employed, shipments under ventilation were discontinued after the first week in November. Refrigeration was employed more or less during the entire month of October. Movements under heat started the last week in October.

These tables were compiled from railroad bills of lading and represent 10,180 carloads of apples shipped from the principal districts of the Northwest between August 15 and December 15, 1917. The records of the Bureau of Markets show that 16,400 carloads were shipped from the entire Northwest up to December 15.

During several weeks in October and November, carloads of apples were found moving eastward in the same train in refrigerator cars under refrigeration, under ventilation, and under heat, and in box cars without any attention whatever. All varieties of apples require the same favorable conditions during transit for their best keeping,

TABLE 1.—*Recapitulation of northwestern carlot shipments of apples.*

[August 15 to December 15, 1917.]

WEEK.	EAST.		WEST.		TOTAL.	
	Refrigerator.	Box.	Refrigerator.	Box.	Refrigerator.	Box.
Aug. 15–30:						
Number of cars	1	----------	21	----------	22	----------
Number of boxes	700	----------	13,443	----------	14,143	----------
Average load	700	----------	640	----------	642.8	----------
Sept. 1–6:						
Number of cars	5	1	10	----------	15	1
Number of boxes	3,468	630	6,505	----------	9,973	630
Average load	693.6	630	650.5	----------	664.8	630
Sept. 7–13:						
Number of cars	7	----------	13	----------	20	----------
Number of boxes	4,593	----------	8,666	----------	13,259	----------
Average load	656.1	----------	666.6	----------	662.9	----------
Sept. 14–20:						
Number of cars	16	----------	17	----------	33	----------
Number of boxes	10,670	----------	11,187	----------	21,857	----------
Average load	666.9	----------	658	----------	662.3	----------
Sept. 21–27:						
Number of cars	44	1	61	----------	105	1
Number of boxes	29,626	630	39,800	----------	69,426	630
Average load	673.3	630	652.4	----------	661.2	630
Sept. 28–Oct. 4:						
Number of cars	183	----------	198	----------	381	----------
Number of boxes	130,116	----------	133,627	----------	263,743	----------
Average load	711	----------	674.8	----------	692.2	----------
Oct. 5–11:						
Number of cars	585	1	517	2	1,102	3
Number of boxes	404,662	752	347,293	1,321	751,955	2,073
Average load	691.7	752	671.7	660.5	682.3	691
Oct. 12–18:						
Number of cars	682	97	639	72	1,321	169
Number of boxes	498,638	79,700	439,654	59,241	938,292	138,941
Average load	731.1	821.6	688	822.7	710.2	822.1
Oct. 19–25:						
Number of cars	553	136	521	118	1,074	254
Number of boxes	438,062	120,072	37,461.4	102,840	812,676	222,912
Average load	792.1	882.8	719.0	871.5	756.6	877.6
Oct. 26–Nov. 1:						
Number of cars	303	93	239	222	542	315
Number of boxes	243,043	88,903	183,583	195,010	426,626	283,913
Average load	802.1	955.9	768	878.4	787.1	901.3
Nov. 2–8:						
Number of cars	295	133	179	308	474	441
Number of boxes	247,819	131,054	141,049	279,344	388,868	410,398
Average load	840.1	985.6	787.9	906.9	820.3	930.6
Nov. 9–15:						
Number of cars	241	190	182	335	423	525
Number of boxes	200,383	171,346	143,493	289,128	343,876	460,474
Average load	831.4	901.8	788.4	863.0	812.9	877
Nov. 16–22:						
Number of cars	264	147	198	259	462	406
Number of boxes	223,415	138,139	160,355	222,359	383,770	360,498
Average load	846.2	939.7	809.8	858.5	830.6	887.9
Nov. 23–29:						
Number of cars	423	42	331	101	754	143
Number of boxes	335,983	40,426	267,660	91,128	603,643	131,554
Average load	794.3	962.5	808.6	902.2	800.5	919.9
Nov. 30–Dec. 7:						
Number of cars	386	1	294	22	680	23
Number of boxes	312,403	686	238,477	20,404	550,880	21,090
Average load	809.3	686	811.1	927.4	810.1	917
Dec. 8–15:						
Number of cars	244	3	238	6	482	9
Number of boxes	192,556	2,293	188,001	5,934	380,557	8,227
Average load	789.1	764.3	789.9	989	789.5	914.1
Total for season:						
Total number of cars	4,232	845	3,658	1,445	7,890	2,290
Total number of boxes	3,276,137	774,631	2,697,407	1,260,543	5,973,544	2,041,340
Average load	774.1	916.7	737.2	872.3	757.1	891.4

Grand total:

Total number of cars, August 15 to December 15	10,180
Total number of boxes, August 15 to December 15	8,014,884
Average load in all cars, August 15 to December 15	787.3

TABLE 2.—*Wenatchee District, Washington: Summary of carlot shipments of apples from Wenatchee and Northern Columbia shipping points.*

[August 15 to December 15, 1917.]

WEEK.	EAST.			WEST.			TOTAL.	
	Refrigerator.	Ventilated.	Box.	Refrigerator.	Ventilated.	Box.	Refrigerator and ventilated.	Box.
Aug. 15–30:								
Number of cars	1			13	1		15	
Number of boxes	700			8,413	522		9,635	
Average load	700			647	522		642.3	
Sept. 1–7:								
Number of cars	5			4			9	
Number of boxes	3,468			2,690			6,158	
Average load	693.6			672.5			684.2	
Sept. 7–13:								
Number of cars	6			9	2		17	
Number of boxes	3,928			6,097	1,309		11,334	
Average load	654.6			677.6	654.5		666.7	
Sept. 14–20:								
Number of cars	11	2		6	3		22	
Number of boxes	7,149	1,382		3,770	2,180		14,481	
Average load	649.9	691		628.3	726.6		658.2	
Sept. 21–27:								
Number of cars	31	7		18	13		69	
Number of boxes	21,019	4,606		11,223	8,970		45,818	
Average load	678	658		623.5	690		664	
Sept. 28–Oct. 4:								
Number of cars	91	39		25	77		232	
Number of boxes	67,804	27,004		16,608	52,928		164,344	
Average load	745.1	699.3		664.3	687.3		708.5	
Oct 5–11:								
Number of cars	181	146	1	50	96	2	473	3
Number of boxes	128,503	106,041	752	34,036	69,492	1,321	338,072	2,073
Average load	709.9	726.3	752	680.7	723.8	660.5	714.7	691
Oct. 12–18:								
Number of cars	217	171	95	63	83	69	534	164
Number of boxes	165,087	130,981	78,388	46,717	62,156	56,811	404,941	135,199
Average load	760.7	765.8	825.1	741.5	748.8	823.3	758.3	824.4
Oct. 19–25:								
Number of cars	156	154	134	37	62	107	409	241
Number of boxes	120,633	119,455	118,350	28,956	49,442	92,973	318,486	211,323
Average load	773.3	775.6	883.2	782.5	797.4	868.9	766.4	876.8
Oct. 26–Nov. 1:								
Number of cars	58	112	74	15	45	95	230	169
Number of boxes	47,053	92,183	71,470	12,282	35,769	88,307	187,287	159,777
Average load	811.2	823	965.8	818.8	794.8	928.4	814.3	945.4
Nov. 2–8:								
Number of cars	154	49	100	53	16	105	272	205
Number of boxes	132,734	41,489	102,276	44,066	13,458	99,229	231,747	201,505
Average load	862.9	846.5	1,022.7	831.6	841.1	945	852	982.9
Nov. 9–15:								
Number of cars	92	1	101	41		113	134	214
Number of boxes	81,104	866	93,725	34,438		103,463	116,408	197,188
Average load	881.5	866	928	839.9		915.6	868.7	921.4
Nov. 16–22:								
Number of cars	128		117	50		82	178	199
Number of boxes	112,690		109,992	43,005		73,044	155,695	183,036
Average load	880.4		940.1	860.1		890.8	874.7	919.8
Nov. 23–29:								
Number of cars	243		31	106		32	349	63
Number of boxes	199,579		30,228	87,119		27,600	286,698	57,828
Average load	821.3		975	821.8		862.5	821.4	917.9
Nov. 30–Dec. 7:								
Number of cars	230		1	76		8	306	9
Number of boxes	188,208		686	61,796		6,387	250,004	7,073
Average load	818.3		686	813.1		798.4	817	785.9
Dec. 8–15:								
Number of cars	89		3	68			157	3
Number of boxes	70,072		2,293	55,144			125,216	2,293
Average load	787.3		764.3	810.9			797.5	764.3
Total for season:								
Total number of cars	1,693	681	657	634	398	613	3,406	1,270
Total number of boxes	1,349,731	524,007	608,160	496,360	296,226	549,135	2,666,324	1,157,295
Average load	797.2	769.4	925.6	782.9	744.2	895.8	782.8	911.3

Grand total:

Total number of cars, August 15 to December 15	4,676
Total number of boxes, August 15 to December 15	3,823,819
Average load in all cars, August 15 to December 15	817.7

TABLE 3.—*Yakima District, Washington: Summary of carlot shipments of apples from Yakima Valley shipping points.*

[August 15 to December 15, 1917.]

WEEK.	EAST.		WEST.		TOTAL.	
	Refrigerator	Box.	Refrigerator.	Box.	Refrigerator.	Box.
Aug. 15–30:						
Number of cars	----------	----------	7	----------	7	----------
Number of boxes	----------	----------	4,508	----------	4,508	----------
Average load	----------	----------	644	----------	644	----------
Sept. 1–6:						
Number of cars	----------	1	6	----------	6	1
Number of boxes	----------	630	3,815	----------	3,815	630
Average load	----------	630	635.8	----------	635.8	630
Sept. 7–13:						
Number of cars	1	----------	2	----------	3	----------
Number of boxes	665	----------	1,260	----------	1,925	----------
Average load	665	----------	630	----------	641.6	----------
Sept. 14–20:						
Number of cars	3	----------	8	----------	11	----------
Number of boxes	2,139	----------	5,237	----------	7,376	----------
Average load	713	----------	654.6	----------	670.5	----------
Sept. 21–27:						
Number of cars	6	1	30	----------	36	1
Number of boxes	4,001	630	19,607	----------	23,608	630
Average load	666.8	630	653.5	----------	655.7	630
Sept. 28–Oct. 4:						
Number of cars	35	----------	96	----------	131	----------
Number of boxes	23,519	----------	64,091	----------	87,610	----------
Average load	672	----------	667.6	----------	668.7	----------
Oct. 5–11:						
Number of cars	211	----------	334	----------	545	----------
Number of boxes	136,645	----------	218,653	----------	355,298	----------
Average load	647.6	----------	654.6	----------	651.9	----------
Oct. 12–18:						
Number of cars	238	2	419	1	657	3
Number of boxes	157,681	1,312	278,286	756	435,967	2,068
Average load	662.5	656	664.1	756	663.5	689.3
Oct. 19–25:						
Number of cars	179	2	355	7	534	9
Number of boxes	147,025	1,722	246,579	6,049	393,604	7,771
Average load	821.3	861	736	864.1	737	863.4
Oct. 26–Nov. 1:						
Number of cars	84	7	141	111	225	118
Number of boxes	63,310	5,677	104,269	92,336	167,579	98,013
Average load	753.7	811	739.4	831.8	744.7	830.6
Nov. 2–8:						
Number of cars	38	16	80	150	118	166
Number of boxes	28,766	13,898	60,107	132,517	88,873	146,415
Average load	757	868.6	751.3	883.4	753.1	882
Nov. 9–15:						
Number of cars	75	43	90	154	165	197
Number of boxes	58,920	34,925	69,761	124,101	128,681	159,026
Average load	785.6	812.2	775.1	805.8	779.8	807.7
Nov. 16–22:						
Number of cars	54	27	95	142	149	169
Number of boxes	43,583	25,635	76,244	119,209	119,827	144,844
Average load	807	949.4	802.5	839.5	804.2	857
Nov. 23–29:						
Number of cars	110	9	171	52	281	61
Number of boxes	78,846	8,382	136,887	47,670	215,733	56,052
Average load	716.7	931.3	800.5	916.7	767.7	918.8
Dec. 1–7:						
Number of cars	105	----------	178	8	283	8
Number of boxes	83,140	----------	145,482	7,882	228,622	7,882
Average load	791.8	----------	817.3	986	807.8	985.2
Dec. 8–15:						
Number of cars	45	----------	113	6	158	6
Number of boxes	35,493	----------	86,556	5,934	122,049	5,934
Average load	788.7	----------	765.9	989	772.4	989
Total for season:						
Total number of cars	1,184	108	2,125	631	3,309	739
Total number boxes	863,733	92,811	1,521,342	536,454	2,385,075	629,265
Average load	729.5	859.3	715.9	850.1	720.7	851.5

Grand total:

Total number of cars, August 15 to December 15	4,042
Total number of boxes, August 15 to December 15	3,014,340
Average load in all cars, August 15 to December 15	745.7

even though some varieties have qualities that enable them to stand abuse longer than others. It follows that when radically diversified methods are employed with cars moving through identical climatic conditions, some of the fruit is subject to undesirable shipping conditions.

Table 1 shows that heavy loading of refrigerator cars was not universally begun until the week of October 19 to 25, and that the heaviest loading occurred during the week of November 16 to 22, when the average carload was 830.6 boxes. This was five weeks after the heaviest movement under ventilation and well into the

TABLE 4.—*Hood River District, Oregon: Summary of carlot shipments of apples from Hood River shipping points.*

[August 15 to December 15, 1917.]

WEEK.	EAST.		WEST.		TOTAL.	
	Refrigerator.	Box.	Refrigerator.	Box.	Refrigerator.	Box.
Oct. 15–Oct. 4:						
Number of cars	18	----------	----------	----------	18	----------
Number of boxes	11,789	----------	----------	----------	11,789	----------
Average load	654.9	----------	----------	----------	654.9	----------
Oct. 5–11:						
Number of cars	23	----------	6	----------	29	----------
Number of boxes	17,260	----------	4,564	----------	21,824	----------
Average load	750.4	----------	760.6	----------	752.5	----------
Oct. 12–18:						
Number of cars	50	----------	27	----------	77	----------
Number of boxes	40,515	----------	19,373	----------	59,888	----------
Average load	810.3	----------	717.5	----------	777.7	----------
Oct. 19–25:						
Number of cars	50	----------	29	----------	79	----------
Number of boxes	41,764	----------	21,697	----------	63,461	----------
Average load	835.2	----------	748.1	----------	803	----------
Oct. 26–Nov. 1:						
Number of cars	30	12	12	3	42	15
Number of boxes	25,699	11,756	10,092	2,922	35,791	14,678
Average load	856.6	979.6	841	974	852.1	978.5
Nov. 2–8:						
Number of cars	29	12	5	28	34	40
Number of boxes	24,704	10,338	4,121	25,181	28,825	35,519
Average load	851.8	861.5	824.2	899.3	847.7	887.9
Nov. 9–15:						
Number of cars	28	38	11	30	39	68
Number of boxes	23,887	35,467	8,902	24,527	32,789	59,994
Average load	853.1	933.3	809.2	817.5	840.7	882.2
Nov. 16–22:						
Number of cars	58	2	17	28	75	30
Number of boxes	47,747	1,704	13,738	24,004	61,485	25,708
Average load	823.2	852	808.1	857.2	819.7	856.9
Nov. 23–29:						
Number of cars	44	----------	10	12	54	12
Number of boxes	36,373	----------	8,430	10,802	44,803	10,802
Average load	826.6	----------	843	900	829.6	900.1
Nov. 30–Dec. 6:						
Number of cars	17	----------	11	3	28	3
Number of boxes	13,316	----------	8,534	2,863	21,850	2,863
Average load	783.2	----------	775.8	954.3	780	954.3
Dec. 7–15:						
Number of cars	90	----------	17	----------	107	----------
Number of boxes	70,970	----------	13,481	----------	84,451	----------
Average load	788.5	----------	793	----------	789.2	----------
Total for season:						
Total number of cars	437	64	145	104	582	168
Total number of boxes	354,024	59,265	112,932	90,299	466,956	149,564
Average load	810.1	926	778.8	868.2	802.3	890.2

Grand total:

Total number of cars, August 15 to December 15	750
Total number of boxes, August 15 to December 15	616,520
Average load in all cars, August 15 to December 15	822

season when heating precautions should have been taken. The best treatment of the apples would have been for the heaviest loads to move under ventilation.

Box cars were not extensively used until the week of October 12 to 18 and their greatest use was during the week of November 9 to 15, when 525 were shipped. Out of 10,180 carloads, shipped from the Northwest, 2,290 loads were shipped in box cars, more than 845 of which had destinations in Eastern States.

Comparing the weekly shipments from different districts, a wide variation is found in the weight of the loads in different shipping localities. During the week of October 12 to 18, the average refriger-

TABLE 5.—*Western Oregon District: Summary of carlot shipments of apples from Medford, Grants Pass, Gold Hill, Voorhies, Dallas, and Ashland.*

[August 15 to December 15, 1917.]

WEEK.	EAST.		WEST.		TOTAL.	
	Refrigerator.	Box.	Refrigerator.	Box.	Refrigerator.	Box.
Oct. 5–11:						
Number of cars	9		3		12	
Number of boxes	6,582		2,181		8,763	
Average load	731.3		727		730.2	
Oct. 12–18:						
Number of cars	2		10	2	12	2
Number of boxes	1,470		7,587	1,674	9,057	1,674
Average load	735		758.7	837	754.7	837
Oct. 19–25:						
Number of cars	3		7	3	10	3
Number of boxes	2,016		4,946	2,393	6,962	2,393
Average load	672		706.5	798	696.2	797.6
Oct. 26–Nov. 1:						
Number of cars	11		7	2	18	2
Number of boxes	8,267		5,074	1,674	13,341	1,674
Average load	751.5		725	837	741.1	837
Nov. 2–8:						
Number of cars	7		6	8	13	8
Number of boxes	5,327		4,871	6,168	10,198	6,168
Average load	761		811.8	771	784.4	771
Nov. 9–15:						
Number of cars	17		18	5	35	5
Number of boxes	12,796		13,962	5,175	26,758	5,175
Average load	752.7		757.6	1,035	764.5	1,035
Nov. 16–22:						
Number of cars	6		8	4	14	4
Number of boxes	4,905		6,085	3,182	10,990	3,182
Average load	817.5		760.6	795.5	785	795.5
Nov. 23–29:						
Number of cars	19	1	16	2	35	3
Number of boxes	15,185	808	12,246	1,956	27,431	2,764
Average load	799.2		765.3	978	783.7	921.3
Nov. 30–Dec. 6:						
Number of cars	29		9	3	38	3
Number of boxes	23,313		6,333	3,272	29,646	3,272
Average load	803.8		703.6	1,091	780.1	1,090.6
Dec. 7–15:						
Number of cars	16		15		31	
Number of boxes	12,997		13,062		26,059	
Average load	812.3		870.8		840.6	
Total for season:						
Total number of cars	119	1	99	29	218	30
Total number of boxes	92,858	808	76,347	25,494	169,205	26,302
Average load	780.3		771.1	879.1	776.1	876.7

Grand total:

Total number of cars, August 15 to December 15	248
Total number of boxes, August 15 to December 15	195,507
Average load in all cars, August 15 to December 15	788.3

ator carloads were as follows: Hood River, 777.7 boxes; Wenatchee, 758.3 boxes; Western Oregon, 754.7 boxes; Eastern Washington, 693.6 boxes, and Yakima, 663.5 boxes. Local storage facilities and competitive transportation conditions to some extent regulate heavy loading activities in different districts.

RECOMMENDATIONS

The following recommendations are based upon the investigations that have been made, as well as upon the results of methods used in commercial practice so far as these have proved efficient and of such practical value as to warrant their wider application.

TABLE 6.—*Eastern District, Washington, Oregon, and Idaho: Summary of carlot shipments of apples from Walla Walla, Lewiston, Milton, Freewater, Mosier, Taggard, and Dufur.*

[August 15 to December 15, 1917.]

Week.	East.		West.		Total.	
	Refrigerator.	Box.	Refrigerator.	Box.	Refrigerator.	Box.
Oct. 5–11:						
Number of cars	15	----------	28	----------	43	----------
Number of boxes	9,631	----------	18,567	----------	27,998	----------
Average load	642	----------	656	----------	651.1	----------
Oct. 12–18:						
Number of cars	4	----------	37	----------	41	----------
Number of boxes	2,904	----------	25,535	----------	28,439	----------
Average load	726	----------	690.1	----------	693.6	----------
Oct. 19–25:						
Number of cars	11	----------	31	1	42	1
Number of boxes	7,969	----------	22,994	1,425	30,963	1,425
Average load	724.4	----------	741.7	1,425	737.2	1,425
Oct. 26–Nov. 1:						
Number of cars	8	----------	19	11	27	11
Number of boxes	6,531	----------	16,097	9,771	22,628	9,771
Average load	816.4	----------	847.2	888.2	838	888.2
Nov. 2–8:						
Number of cars	18	5	19	17	37	22
Number of boxes	14,799	4,542	14,326	16,249	29,125	20,791
Average load	821.0	908.4	754	955.8	787.1	945
Nov. 9–15:						
Number of cars	28	8	22	33	50	41
Number of boxes	22,810	7,229	16,430	31,862	39,240	39,091
Average load	814.6	903.6	746.8	965.5	784.8	953.4
Nov. 16–22:						
Number of cars	18	1	28	3	46	4
Number of boxes	14,490	808	21,283	2,920	35,773	3,728
Average load	805	808	760.1	973.3	777.7	932
Nov. 23–29:						
Number of cars	7	1	28	3	35	4
Number of boxes	6,000	1,008	22,978	3,100	28,978	4,108
Average load	857.1	1,008	820.6	1,033.3	827.9	1,027
Nov. 30–Dec. 6:						
Number of cars	5	----------	20	----------	25	----------
Number of boxes	4,426	----------	16,332	----------	20,758	----------
Average load	885.2	----------	816.6	----------	830.3	----------
Dec. 7–15:						
Number of cars	4	----------	25	----------	29	----------
Number of boxes	3,024	----------	19,758	----------	22,782	----------
Average load	756	----------	790.3	----------	785.6	----------
Total for season:						
Total number of cars	118	15	257	68	375	83
Total number of boxes	92,584	13,587	194,100	65,327	286,684	78,914
Average load	784.6	905.8	755.2	960.6	764.5	950.7

Grand total:

Total number of cars, August 15 to December 15 ---------- 458

Total number of boxes, August 15 to December 15 ---------- 365,598

Average load in all cars, August 15 to December 15 ---------- 798.2

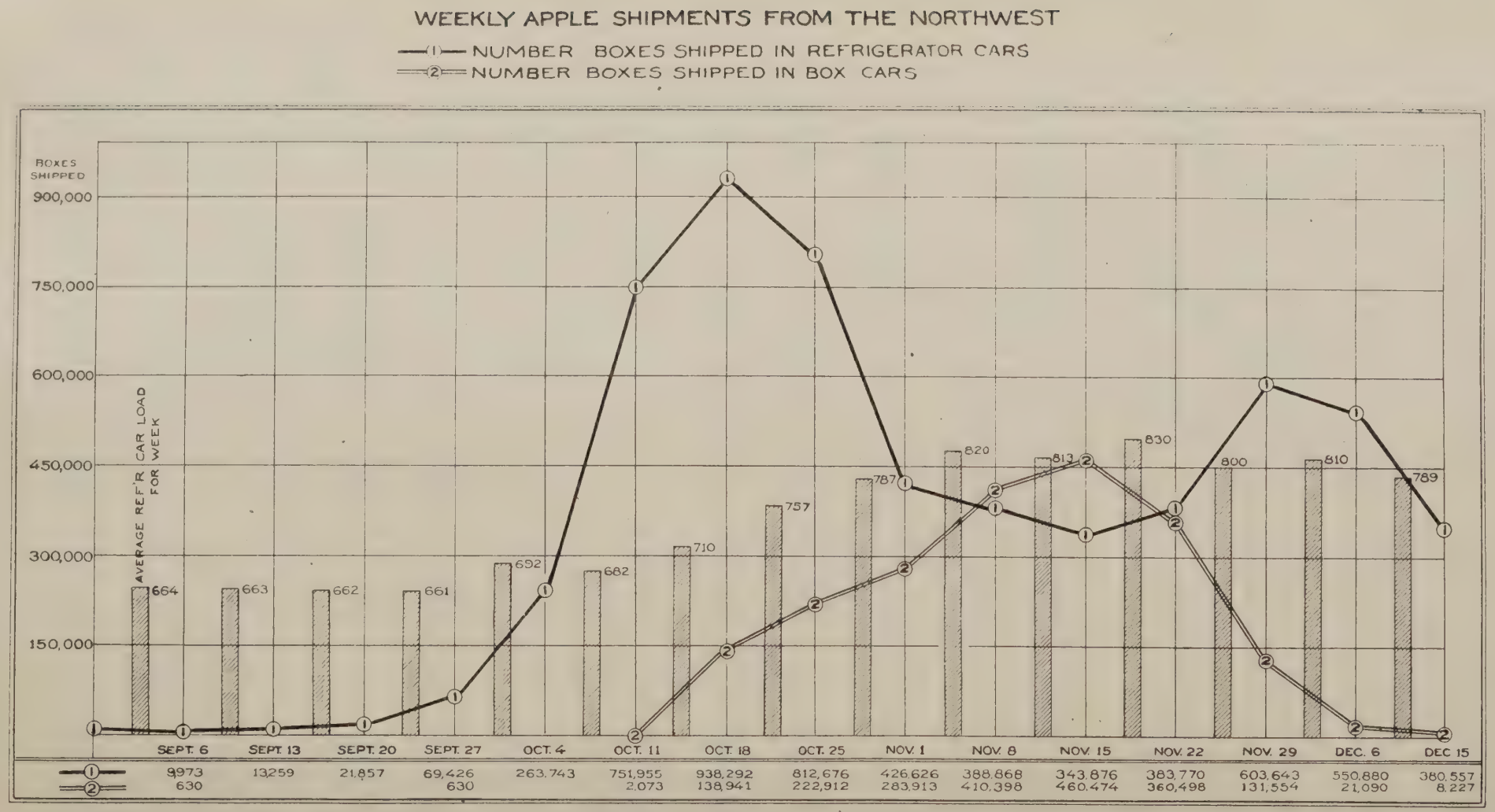

FIG. 7.—Diagram covering 10,180 of the 16,400 carloads of apples shipped out of the Northwest up to December 15, season of 1917, showing the number of boxes shipped weekly in box cars and in refrigerator cars, and the average number of boxes in refrigerator carloads by weeks. The "peak" of the shipments in box cars marks the most acute stage of the refrigerator car shortage. Heavy loading was deferred until the car shortage was felt.

LOADING

The loading of refrigerator cars with apples nearer the ceiling than 18 inches is not recommended as a standard practice.

Early long-distance shipments should move under refrigeration and ordinarily should not be loaded more than five boxes high. These shipments should include the September and early October movement of such varieties as Grimes, Jonathan, Winter Banana, McIntosh, Delicious, and Spitzenberg.

By using 3 to 4 per cent salt with the ice at the time of loading, such carloads may be increased, under emergency demands, to six layers, but in no case should salt be used unless properly constructed floor racks are provided and the fruit next to the ice bunker is protected from freezing by an insulated bulkhead or temporary insulating material so placed as to provide ample openings at the floor and ceiling to permit free air circulation to and from the ice bunker.

When emergency necessitates increased loading, ventilated shipments, rather than those moving under refrigeration or heat, should be loaded heavily.

STRIPPING AND BRACING

The following rules should be put into effect at every loading platform:

(1) Inspect bunker bulkheads and insure rigidity before loading, by bracing those likely to work loose.

(2) Clean out the cars beneath the floor racks before loading.

(3) Use floor racks having not less than 4-inch supports running lengthwise of the car. Do not load boxes on temporary strips, as they are of no importance in applying heat and often tilt or allow the boxes to slip off, resulting in a jumbled load and breakage.

(4) Place boxes an even distance apart, keep them in even stacks across the car, and have each box shoved firmly back to prevent slack.

(5) Use two car strips per box on the second, fourth, and top layers of boxes in each stack. Have each strip extend to the walls of the car. Use No. 6 cement-coated nails in the top strips, *two nails per box in each strip*. On lower strips use at least one nail per box in each strip.

(6) When loading the doorway full, squeeze the load well with a car squeeze before placing the final stack of fruit, and take up all slack with dunnage. Allow sufficient space above the load in the doorway for the entrance of inspectors.

(7) Brace tightly with good lumber, using construction with strength equivalent to that shown in figure 8.

Controlled ventilation maintains lower and more even fruit temperatures than standard ventilation. (See fig. 3.) It is recommended that ventilation practices be established that will effect the prompt opening and closing of ventilators by competent employees, in order

that full advantage may be taken of favorable outside temperatures for maintaining desirable and uniform fruit temperatures. Until adequate service in this respect is established by the carriers it is believed desirable that the shippers extend the messenger service that they have provided for protection against freezing for the purpose of regulating ventilation of cars in transit.

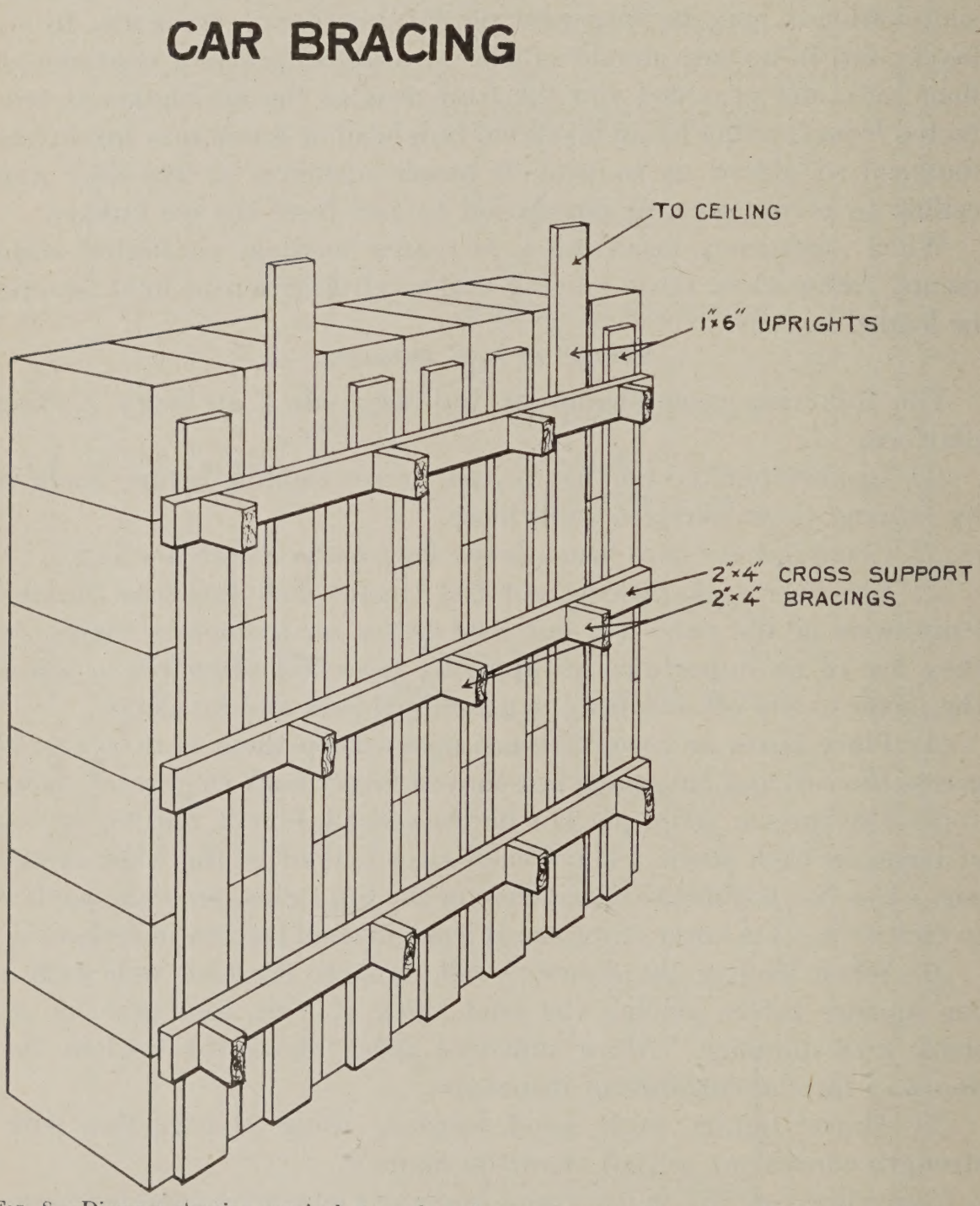

FIG. 8.—Diagram showing required strength and proper construction of car bracing for carloads of boxed apples. The load should be kept tight when placing boxes and should be well squeezed with bracings made of sound lumber.

THE USE OF BOX CARS IN EMERGENCIES

Box cars are not suitable for long-distance fruit shipments, and their use for transporting perishable food products should be restricted, in so far as practicable, to short-haul shipments.

Tables 1 to 6 and the diagram in figure 7 show that during 1917 the supply of cars at hand in the Northwest was not used to the best advantage. Heavy loading was not practiced extensively until the car shortage was actually felt. Instead of loading cars heaviest when shipments were moving under ventilation, this was not done until several weeks after the normal season for ventilated shipments. Box cars were not utilized until the supply of refrigerator cars was practically exhausted, with their greatest use coming after favorable weather conditions were past. They were then used indiscriminately for all shipments, whether consigned to markets in adjoining States, or to those on the Atlantic seaboard.

It is recommended that shippers and carriers, through their representatives, meet periodically to compare the tonnage to be moved with the apparent car supply. When conditions apprehend the necessity for heavy loading or for the use of unsuitable equipment, such as box cars, as was the case in 1917, it would then be possible to effect heavy loading when shipping under ventilation rather than wait for the shortage to be actually visible, and box cars would be utilized over the entire season, but only for such fruit as ordinarily reaches a nearby market. The best regulation of loading and shipping cannot be made effective if the carriers and shippers work independently.